SECTION 33 20 01.01 00

ELECTRICAL GROUND WELLS

PART 1 GENERAL

1.1 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C206	(2011) Field Welding of Steel Water Pipe

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM C 150	(2015) Standard Specification for Portland Cement
ASTM D5088	(2015) Decontamination of Field Equipment Used at Nonradioactive Waste Sites
ASTM D5608	(2016) Decontamination of Field Equipment Used at Low Level Radioactive Waste Sites

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE C2	(2012; Errata 1 2012; INT 1-4 2012; Errata 2 2013; INT 5-7 2013; INT 8-10 2014; INT 11 2015) National Electrical Safety Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

STATE OF ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION (ADEC)

18 AAC 80	(2014) Drinking Water

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-HDBK-419	(1987; Rev A) Grounding, Bonding, and Shielding for Electronic Equipments and

1.2 GENERAL REQUIREMENTS

Ground wells to provide electrical grounding shall be located as shown on the drawings. Each ground well shall be of sufficient depth to penetrate into a desirable water-bearing stratum a minimum of 30 feet **AM#9...** below draw down level shown.**...AM#9** The ground well shall be connected to the facility ground loop(s) with bare copper conductors of size and location as shown on the drawings.

Prior to drilling the ground well, the contractor shall apply visual checks and use a conductivity meter to assure there are no underground utilities, cables, structures, or other appurtenances within a twenty foot radius of the location. The contractor may determine the exact location of the wells within a ten-foot radius of the location as shown on the drawings. Should the contractor be unable to move this distance and avoid any underground obstructions, the contracting officer shall be notified immediately to obtain appropriate guidance.

1.3 SUBMITTALS

Approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submittals with an "S" designation following the “G” are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29.01 00 SUSTAINABILITY REPORTING. Other designations following the "G" designation identify the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00.01 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Permits; G, R

Work Plan; G, R

SD-06 Test Reports

Tests; G, R

Water Source

Test Reports within 24 hours following the conclusion of each test.

SD-07 Certificates

Qualifications; G, R

A certification that contains the names and qualifications of people to perform electrical resistance measurements shall be provided.

SD-11 Closeout Submittals

As-Built; G, R

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Borehole Logs; G, R

An accurate log maintained during the drilling of the well. Well logs shall be prepared from observations of drill operation and from cuttings taken from the return line. The Contractor shall prepare a graphic boring log to scale showing the required details. Six prints of the boring log drawing shall be submitted.

Well Completion Report; G, R

1.4 QUALITY ASSURANCE

1.4.1 Work Plan

Before beginning work, submit a proposed plan for drilling and constructing ground wells. The plan shall include, but shall not be limited to, the proposed method of drilling and equipment to be used as well as details on proposed casing and grouting material. Work shall not be performed until the drilling plan has been approved and deviation from the approved drilling plan will not be permitted without approval of the Contracting Officer. Details of specific methods to be employed to control potential contamination or pollution arising from well installation activities, shall also be included.

1.4.2 Permits

Submit a copy of all permits, licenses, or other legal requirements necessary for execution of the work. Before beginning work, the local United States Geological Survey office (USGS) **AM#9.....AM#9**shall be notified of the type and location of wells to be constructed, the method of construction, and the anticipated schedule for construction of the wells. A copy of all such correspondence shall be furnished.

1.4.3 Qualifications

A certification that contains the names and qualifications of people to perform well installation and electrical resistance measurements shall be provided. **AM#9...**Document **...AM#9** a minimum of 3 years of well installation experience.

1.5 ENVIRONMENTAL PROTECTION

The Contractor shall take necessary precautions to prevent contaminated water, or water having undesirable physical or chemical characteristics, from entering the water supply stratum through the well bore or by seepage from the ground surface; and shall prevent contamination of the ground surface or of surface waters resulting from drilling of the well.

1.6 ABANDONMENT OF WELLS

If the Contractor fails to construct a well of the required depth, or if the well is abandoned because of loss of tools or for any other cause, the Contractor shall fill the abandoned hole with sand-cement grout and remove the casing. Grout shall meet the requirements of paragraph 2.2 CEMENT GROUT. No payment will be made for a well that fails to meet the required depth or for a well considered abandoned. The location for a replacement well, if required, will be as directed by the Contracting Officer.

PART 2 PRODUCTS

2.1 CASING

Casing diameter shall be as shown, conforming to ASTM A53/A53M, black, Schedule 40, Type E or S, Grade A or B. Grounding wells shall match the depth as shown on the Drawings. All casing, and other well material shall be of compatible materials to prevent galvanic reaction between components of the completed well. Submit catalog data, and name of supplier, for well vaults, caps, airline oil filters for pneumatic drilling, pumps, and chemical specifications on drill lubricants, tracers, disinfecting agents, and drill fluid additives, if used. Catalog data shall include any information, written or otherwise, supplied by the manufacturers or suppliers of the above listed items.

2.1.1 Steel Casing and Couplings

Steel casing shall be new standard weight black steel pipe, conforming to ASTM A53/A53M 6 inch diameter, minimum 1/4 inch wall thickness. Joints shall be field welded in accordance with AWWA C206.

2.2 CEMENT GROUT

Cement grout shall consist of portland cement conforming to ASTM C 150, Type I or II, sand and water. Cement grout shall be proportioned not to exceed 6 gallons of water per cubic foot of cement, with a mixture of such consistency that the well can be properly grouted. No more than 5 percent by weight of bentonite powder may be added to reduce shrinkage.

PART 3 EXECUTION

3.1 **AM#9.....AM#9**
3.2 PREPARATION

3.2.1 Decontamination

The drill rig, drill rods, drill bits, augers, temporary casing, well developing equipment, tremie pipes, grout pumping lines, and other associated equipment shall be cleaned with high-pressure hot water/steam prior to drilling at each well location. Decontamination shall be done in accordance with ASTM D5088 or ASTM D5608. Decontamination shall be performed at a central decontamination station. Cleaning shall be performed in an area that is remote from, and cross- or down-gradient from the well being drilled. Well casing shall be cleaned with high-pressure hot water immediately prior to installation in the well. The use of factory sealed (plastic wrapped) components does not waive this requirement for pre-installation cleaning.

3.2.2 Decontamination Station

Construct a temporary decontamination pad onsite. Berm the pad and slightly incline towards a sump located in one of the back corners of the pad. Line the pads and berms with plastic sheeting to contain decontamination water. Place plywood sheeting, exterior grade, over the plastic sheeting to prevent damage to the plastic and allow the drill rig and heavy equipment to use the pad. The minimum dimensions of the pad shall be the length and width of the drill rig, plus 4 feet per side to allow access and steam cleaning. Use yellow ribbon to encircle the

decontamination pad. Pump water collected in the sump using a "trash" pump to transfer water to a 55 gallon drum labeled "Decontamination Pad Sump Water." Transfer solid waste to a separate 55 gallon drum labeled "Decontamination Pad Sump Sludge."

3.2.3 Water Source

Well construction requires the use of water. Prior to its use at the site, the water source shall be sampled and tested, and approved by the Contracting Officer for the constituents specified in 18 AAC 80.205, Table B, requirements for a Community or Non-Transient Non-Community Water Source. Submit decontamination and drilling water source analytical test results, within 14 working days before beginning drilling operations. The Contractor is responsible for locating the source, obtaining the water from the source, transporting it to, and storing it at the site. A water sample shall be obtained from the container used in transporting the water to the site before the water is used for decontamination. This sample shall be tested and approved in accordance with the above requirements. If the water source is a potable water source that has received approval to operate from the State of Alaska Department of Environmental Conservation, water source sampling and testing is not required. In all cases, a water sample is obtained and tested from the container used for transporting.

3.3 WELL CONSTRUCTION

The method of drilling shall be capable of advancing the casing as the boring is progressed. The method shall be approved by the Contracting Officer and shall conform to all state and local standards for water well construction. The execution of the work shall be by competent workmen and shall be performed under the direct supervision of an experienced well driller. Casing pipe and joint couplings shall be of compatible materials throughout each well. The well shall be drilled straight, plumb, and circular from top to bottom. The well shall fully penetrate the water bearing stratum a minimum of 30 feet. **AM#9...**Depth of grout around well shall be a minimum of 10 feet....**AM#9**

3.4 GROUNDING SYSTEMS

NFPA 70 and IEEE C2, except each grounding well shall have a resistance to solid earth ground not exceeding 5 ohms.

3.4.1 Grounding Electrodes

Provide cone pointed ground rods installed to as shown supported by vertical ground cable. Ground rods shall extend 20 feet below water level draw down elevations. Ground rods shall be connected to ground wire with over clamps as shown.

3.4.2 Grounding Connections

Make grounding connections between ground well and ground grid with compression and bolted connections as shown. Provide a ground lead connection to existing observation and water wells by exothermic weld before bolting.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not

acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies must be as recommended by the manufacturer. An embossing die code or other standard method must provide visible indication that a connector has been adequately compressed on the ground wire.

3.4.3 Grounding Conductors

Provide bare grounding conductors. Ground metallic frames and covers of handholes and pull boxes with a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.5 Sealing

When the installation is complete, seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals must be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.6 GROUND WELL ENCLOSURE

Ground well handhole shall be installed 3 inches above surrounding finish grade with grade sloped at 1 inch per foot in all directions from the upper finished surface of the handhole. Electrical ground rods, anchors, supports and cable shall be installed as shown.

3.7 TESTS

3.7.1 Grounding System

a. Visual and mechanical inspection

Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

Perform ground-impedance measurements utilizing the fall-of-potential method in accordance with IEEE 81. Perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Measure the resistance-to-ground of each well using a ground test instrument (Megger DET2/2 or equivalent) per MIL-HDBK-419 Section 2.7.2 using the fall-of-potential method. Record each well's resistance. Provide site diagram indicating location of test probes with associated distances, and provide a plot of resistance vs. distance.

3.8 CLEAN-UP

Upon completion of the well construction and other incidentals, all debris and surplus materials resulting from the work shall be removed from the jobsite.

3.9 SURVEYS

Coordinates and elevations shall be established for each well hole.

Horizontal coordinates shall be determined to the closest 1.0 foot and referenced to both the State Plane Coordinate System, and the project coordinate system. If the State Plane Coordinate System/UTM is not readily available, an existing local grid system shall be used. A ground elevation to the closest 0.1 foot shall be obtained at each well casing and ground well enclosure lid. The highest point on the top of the riser pipe will serve as a measurement point. The elevation of the ground well shall reference this point, and shall be surveyed to the nearest 0.1 foot using the project vertical datum. The location, identification, coordinates, and elevations of the well and monuments shall be provided on the site electrical system record plans.

3.10 DOCUMENTATION AND QUALITY CONTROL REPORTS

Establish and maintain documentation and quality control reports for well construction to record the desired information and to assure compliance with contract requirements, including, but not limited to, the following:

3.10.1 Borehole Logs

A borehole log shall be completed for each boring drilled. Borehole logs shall be prepared by the geologist present onsite during all well drilling and installation activities. The log scale shall be 1 inch equals 1 foot. Copies of complete well logs shall be kept current in the field at each well site and shall be available at all times for inspection by the Contracting Officer. Information provided on the logs shall include, but not be limited to, the following:

a. Name of the project and site.

b. Boring/well identification number.

c. Location of boring (coordinates, if available).

d. Make and manufacturer's model designation of drilling equipment and name of drilling firm.

e. Date boring was drilled.

f. Reference data for all depth measurements.

g. Name of driller and name and signature of geologist preparing log.

h. Nominal hole diameter and depth at which hole diameter changes.

i. Total depth of boring.

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k. Depth of each change of stratum. If location of strata change is approximate, it shall be so stated.

l. Description of the material of which each stratum is composed, in accordance with standard rock nomenclature. Soil parameters for logging shall include, but shall not be limited to, classification, depositional environment and formation, if known, Unified Soil Classification Symbol, secondary components and estimated percentages, color, plasticity, consistency (cohesive soil), density (non-cohesive soil), moisture content, structure and orientation, electrical

conductivity and grain angularity. Classification shall be prepared in the field at the time of sampling. The results of visual observation of the material encountered, and any unusual odor detected shall also be duly noted and recorded.

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o. Depth to water**AM#9.... ...AM#9**

p. Box or sample number. Depths and the number of the core boxes and/or samples shall be recorded at the proper interval.

3.10.2 Installation Diagrams

The well will not be accepted before the geologic logs and installation diagrams are received. Submit As-built installation diagram for each well installed, prepared by the geologist present during well installation operations, within 14 working days of the completion of the well installation procedure. The diagram shall illustrate the as-built condition of the well and include, but not be limited to, the following items:

a. Name of the project and site.

b. Well identification number.

c. Name of driller and name and signature of the geologist preparing diagram.

d. Date of well installation.

e. Description of material from which the well is constructed, including well casing/riser pipe, diameter and schedule of casing, grout type (cement or high-solids bentonite) and type of protective cover (protective casing or flush-to-ground),if used.

f. Total depth of well.

g. Nominal hole diameter.

h. Type of cement used, mix ratios of grout, method of placement and quantities used.

i. Elevations/depths/heights of key features of the well, such as top of well casing/riser pipe, ground surface, the depth of maximum frost and penetration (frost line).

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k. Well location by coordinates. A plan sheet shall also be included showing the coordinate system used and the location of each well. A plan sheet is not required for each well installation diagram; multiple wells may be shown on the same sheet.

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n. Description of surface completion.

3.10.3 Project Photographs

Before, during, and after completion of work, take a minimum of 3 views of each well installation. Photographs shall be 3 by 5 inch color prints. The photographs shall be printed and enclosed with the well completion report. Each color print shall show an information box. The box shall be typewritten and arranged as follows:

Project No.	Contract No.
Contractor/Photographer:	
Photograph No.	Date/Time
Description:	
Direction of View:	

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